Radar Observations of Asteroid 25143 (1998 SF36)

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We observed this object, which currently is the target of the MUSES-C sample-return mission, during its spring 2001 close approach, at Arecibo on twelve dates during March 18 - April 9 and at Goldstone on nine dates during March 20 - April 2. On almost every date we made delay-Doppler images using the finest delay (range) resolution available, 100 ns (15 m) at Arecibo and 125 ns (19 m) at Goldstone. The Arecibo images are much stronger, but the Goldstone sequences typically are about three times longer and therefore provide more rotation-phase coverage.

The asteroid's radar polarization ratio at 13 cm, 0.27 +- 0.04, is comparable to Eros' (0.22 +- 0.06; Ostro et al. 1991, Astron. J. 102, 1490) so the small-scale (cm-to-m) roughness of the surface probably is comparable to Eros'. 1998 SF36's radar albedo, a crude indicator of near-surface bulk density, appears to be within a factor of two of the lunar value (~0.07) but significantly less than Eros' (~0.2).

1998 SF36 probably is more than twice as long as it is wide. A rough first approximation is an ellipsoid with overall dimensions of 250 +- 30 meters by 630 +- 60 meters. However, the two ends are different distances from the center of mass and also have different curvatures, so the asteroid's pole-on silhouette is not axisymmetric. The images show brightness features that probably are due to surface concavities, but the edges of the object are fairly smooth at the scale of our imaging resolution.

We used the optically derived synodic rotation period (12.15 +- 0.03 h; Tomasz Kwiatkowski, pers. comm.) to search for pole directions consistent with the subjectively estimated epochs of two end-on orientations and one broadside orientation in the Arecibo images. The results suggest a sidereal period closer to 12.12 h than to 12.15 and offer two pole solutions: either (320 +- 30, -75 +- 15) or (230 +- 15, -5 +- 15).